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DESTRUCTIVE EFFECT OF EROSION ON SOVIET SOIL

G. V. Lopatin

/Figures are appended/

Flowing water, next to wind, is the main cause of soil erosion. Other erosion processes, such as land slides and earth creeps, usually have only local significance.

Flowing water brings about shifts of soil from one place to another by carrying the soil down rivers in suspended, accretive, and dissolved forms. The extent of these processes is measured by expert observers at hydrological stations. Table 1 shows a tabulation of these observations.

Table 1. Quantity of Solid and Dissolved Matter Carried by Rivers in European USSR and in Northern Caucasus

River	Watershed Area (sq km)	Water Flow (cu km)	Suspended Matter (Millions of tons)	Accretive Matter (Millions of tons)	Dissolved Matter (Millions of tons)	Total (Millions of tons)	Ratio of Suspended to Dissolved Matter
White and Barents Seas							
Pechora	326,930	129	6.5	0.65	5.5	12.65	1.18
Mezen' (at Malonisa-gorskoye)	76,480	26	0.78	0.08	1.26	2.12	0.62
N Dvina	360,300	111	5.84	0.58	17.3	23.72	0.34

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Table 1 (Continued)

River	Watershed Area (sq km)	Water Flow (cu km)	Suspended Matter (Millions of tons)	Accretive Matter (Millions of tons)	Dissolved Matter (Millions of tons)	Total (Millions of tons)	Ratio of Suspended to Dissolved Matter
Onega	57,570	18	0.2	0.02	1.1	1.32	0.18
Total	821,280	284	13.3	1.33	25.2	39.81	0.53
Baltic Sea							
Neva	282,300	82	0.82	0.08	2.87	3.77	0.29
Luga (at Kinoshi)	12,640	3.2	0.05	0.01	0.22	0.28	0.23
Narova	56,000	14	0.21	0.01	0.98	1.20	0.23
S Dvina	84,440	21	0.52	0.03	2.10	2.65	0.25
Total	435,380	120.2	1.60	0.13	6.17	7.9	0.26
Black and Azov Seas							
Dnestr	71,990	10	2.5	0.25	3.04	5.79	0.82
Dnepr	503,360	53	2.0	0.20	8.63	10.83	0.23
S Bug (at Aleksandrovka)	46,200	2.65	0.53	0.05	0.63	1.21	0.84
Don	422,500	28	7.75	0.77	9.27	17.79	0.84
Kuban'	61,530	11	11.0	1.26	2.2	14.46	5.0
Total	1,105,580	104.65	23.78	2.8	23.77	50.35	1.0
Caspian Sea							
Volga	1,380,000	255	25.7	1.3	45.0	72.0	0.57
Ural	220,000	11	4.1	0.2	3.32	7.62	1.24
Terek	43,710	11	25.8	4.0	5.5	35.3	4.69
Sulak	13,370	5.6	26.8	4.0	2.8	33.6	9.57
Samur	3,750	2.0	6.26	0.9	1.0	8.16	6.26
Kuma	21,590	0.38	0.72	0.15	0.19	1.06	3.79
Kalaus	9,380	0.07	0.35	0.04	0.05	0.44	7.00
Total	1,691,800	285.1	89.7	10.6	57.9	158.2	1.55

In 1946, B. V. Polyakov prepared a soil erosion map of European USSR. According to this map, soil erosion from water action reaches 2 tons per hectare per year in the area north of the Volga River, in the basin of the Baltic Sea rivers, in the upper and middle parts of the Dnestr River Basin, in the Pre-Caspian Lowland, and on the northern shores of the Black and Caspian seas. Soil erosion greater than 5 tons per hectare per year occurs in the Central Russian Upland, a large part of the Don River Basin, along the right bank of the Volga below the mouth of the Oka, along the left bank of the Volga from the city of Kazan' to the city of Kuybyshev, in the Podol'sk Upland, and in a considerable part of the Kuban' River Basin. Comparison with actual observations have shown, however, that Polyakov's figures are from 1.5 to 3.0 times too low.

To clarify the question as to what part of eroded soil is "transit" eroded soil, or soil that is carried by the rivers out of the limits of their basins, the author converted the absolute values of suspended, accretive, and dissolved matter carried by the rivers into relative values (Table 2) and compiled maps (Figures 1 and 2) showing the distribution of some of these relative quantities in European USSR and in the northern Caucasus.

In computing the average depth of the layer of soil lost by "transit" erosion, the author, for simplicity of computation, assumed that the volumetric weight of the eroded soil equaled 1.5 tons per cubic meter. This figure agrees on an average with data available on this subject. However, when more detailed computations are made for individual regions, volumetric weight values which are correct for each locality should be used.

Table 2. Properties of Solid and Dissolved Matter Carried by Rivers of European USSR and of Northern Caucasus

River	Avg Drainage Rate (liters/sq km)	Avg Siltiness of Water (gr/cu m)	Avg Salinity of Water (gr/cu m)	Transit Part of Soil Eroded Annually T/sq km	T/ha	Avg Depth of Layer of Transit Soil Eroded Annually (mm)
White and Barents Seas						
Pechora	12.5	50	43	38.7	0.39	0.026
Mezen' (at Malonisagorskoye)	11.0	30	48	27.8	0.28	0.019
N Dvina	9.8	53	156	65.8	0.66	0.044
Onega	10.0	11	61	22.9	0.23	0.015
Avg	--	--	--	48.5	0.48	0.032
Baltic Sea						
Neva	9.2	10	35	13.4	0.13	0.009
Luga (at Kinoshi)	8.0	15	70	17.4	0.17	0.015
Narova	7.7	15	70	21.4	0.21	0.014

Table 2 (Continued)

River	Avg Drainage Rate (liters/sq km)	Avg Siltiness of Water (gr/cu m)	Avg Salinity of Water (gr/cu m)	Transit Part of Soil Eroded Annually T/sq km	Transit Part of Soil Eroded Annually T/ha	Avg Depth of Layer of Transit Soil Eroded Annually (mm)
S Dvina	8.0	25	100	31.4	0.31	0.021
Avg	--	--	--	18.2	0.18	0.012
Black and Azov Seas						
Dnestr	4.6	250	304	80.6	0.81	0.054
Dnepr	3.1	37	163	21.6	0.22	0.014
S Bug (at Aleksandrovka)	1.8	200	242	26.1	0.26	0.017
Don	2.1	277	331	42.2	0.42	0.028
Kuban'	5.9	1,000	200	237.0	2.37	0.157
Avg	--	--	--	45.6	0.46	0.031
Caspian Sea						
Volga	5.9	101	176	52.2	0.52	0.035
Ural	1.6	373	302	34.6	0.35	0.023
Terek	8.0	2,350	500	80.8	8.08	0.538
Sulak	14.0	4,790	500	251.6	25.16	1.677
Samur	17.0	3,130	500	217.6	21.76	1.450
Kuma	0.6	1,900	500	49.4	0.49	0.033
Kalaus	0.24	5,000	500	46.9	0.47	0.031
Avg	--	--	--	93.4	0.93	0.062

The map of average annual siltiness of the rivers (Figure 1) is more complete than a similar earlier map by the author. Also, new data has revealed a clearer picture of the northern and eastern parts of the territory depicted and has made the representation of the other regions more precise.

The map showing how much eroded soil is transit eroded soil, or how much of eroded soil the rivers carry beyond the limits of their basins in the form of suspended matter (Figure 2), indicates that this part of eroded soil ranges from less than 8 to more than 800 tons from a square kilometer per year.

It has not yet been possible to make up similar maps to show how much eroded soil is carried by the rivers beyond their basins in the form of accretive and dissolved matter, because adequate data is lacking.

The last column of Table 1 gives the ratios between suspended matter and dissolved matter carried by the rivers. It is striking that these ratios become progressively greater for the southern and southeastern rivers. Similarly, the salinity and siltiness of their water increase from north to south, and particularly toward the southeast. However, the increase in salin- is at a lower rate than the increase in siltiness.

It should be noted that the last column of Table 2 shows only the depth of the layer of topsoil eroded annually which is carried by the rivers beyond the limits of their basins. Here again it is generally true that the depth of this layer increases from north to south. It is lowest in the northwest, greatest in the northern Caucasus.

The erosion processes of the last 12 - 14 years are beginning to attract more and more attention from Soviet research specialists. This is true because erosion processes are related to each other in one way or another and influence the natural conditions which form the sphere of man's practical and scientific activity.

The grandiose projects announced by the Council of Ministers USSR and the Central Committee of the Communist Party on 24 October 1948 for assuring big crops in the steppe and forest steppe regions of European USSR are intimately connected with the problem of soil erosion and the loss of soils from the effect of flowing water.

[Figures follow]

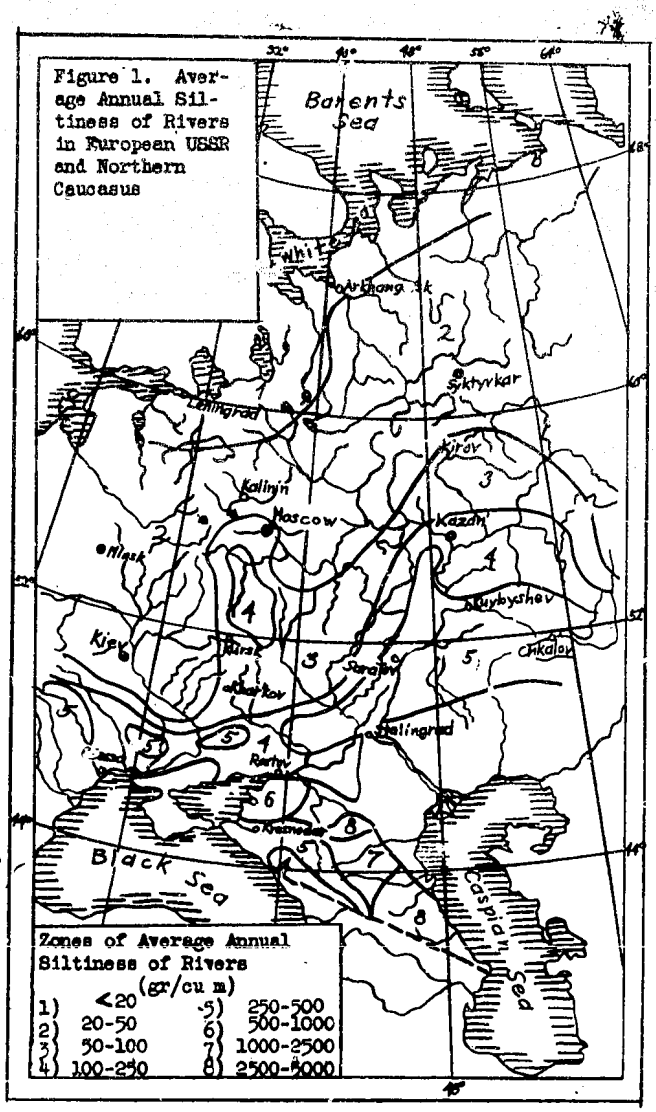
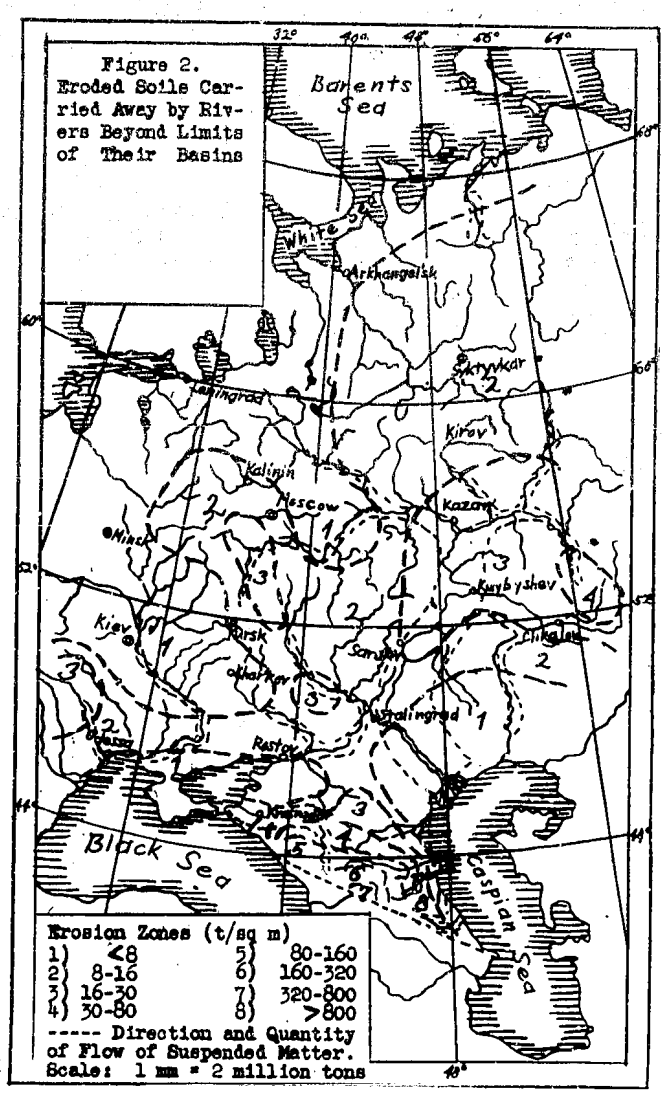


Figure 1. Average Annual Siltiness of Rivers in European USSR and Northern Caucasus



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